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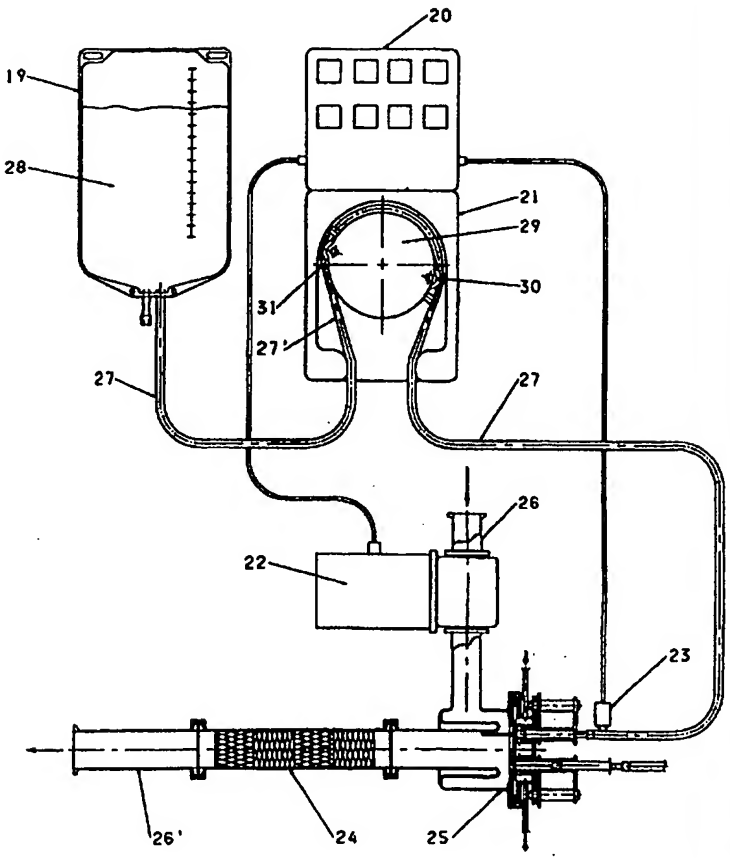
(57) Abstract

The present invention relates to a dosing device or mixing device for mixing in a continuous process a flowing primary liquid with one or more added secondary liquids of a smaller quantity for obtaining a flowing liquid mixture at a permanent uniform mixing ratio of the mixed liquids.



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DOSING DEVICE FOR MIXING IN A CONTINUOUS PROCESS A FLOWING PRIMARY LIQUID WITH ONE OR MORE ADDED SECONDARY LIQUIDS

The present invention relates to a dosing device or mixing device for mixing, in a continuous process, a flowing primary liquid with one or more added secondary liquids for obtaining a flowing liquid mixture at a permanent, uniform mixing ratio of the mixed liquids. Especially the processing industry and medicinal technology require access to dosing devices, by means of which two or more components in liquid state are continuously mixed with each other under conditions which yield uniform mixing ratios, i.e. uniform amounts of the components included, in a continuous mixing process. The device and the method according to the invention are especially applicable in the cases where one or some components, so-called secondary components, are to be admixed to a flowing primary component and where the amount of secondary components in terms of volume is comparatively small or very small compared with the amount of the primary component in the finished mixture. In some cases, it is thus desirable to add enzymes, colourants, flavouring agents, vitamins etc. In a flowing quantity of liquid, the content of the added substances, the so-called secondary components, can be as low as 0.05-1% of the flowing primary component. It is possible by using the inventive method to obtain, with a uniform and continuous mixing ratio, a flow of liquid which can proceed to be packed with an equal content of additives in all packings. An example of such a process is, for instance, the preparation of lactose-free sterile milk, where the untreated sterilised and lactose-containing milk is continuously mixed with a quantity of sterile-filtered lactase before packing, the proportions of lactose-containing milk/lactase being in the order of 5-10,000, about the same mix-

ing ratio being required in all packings that are continuously prepared. In some other cases, higher contents of secondary liquid are required as addition, for instance when colouring or flavouring foodstuffs.

Dosing equipment for mixing flows of liquid having different flow ratios is known, but such equipment has essentially been directed to obtaining a constant mixing ratio by letting the combined flows of liquid being joined and conducted in a loop, i.e. a certain part of the flow of liquid is deflected from the main conduit and recirculated to a point in the flow conduit which is positioned downstream. The mixed liquid or parts thereof will in this manner circulate several times through the loop to obtain a good mixing when the loop has finally been passed. The present invention, which operates without a mixing loop, is considerably simpler in its technical design and permits great flexibility as regards the amount and type of additives and is, above all, easier to adjust between the use of different mixing components. The dosing device according to the invention preferably is adapted to be used in the foodstuff industry but may also be used in medicinal industry for continuous mixing of components in liquid state.

An embodiment of the invention will be described below with reference to the accompanying schematic drawing, in which Fig. 1 illustrates the dosing device, Fig. 2 illustrates a special device with a plurality of needle-like nozzles for supplying a secondary liquid and Fig. 3 shows a flexible plastic bag for storing sterilised secondary liquid. As mentioned above, the described device comprises a means for mixing, with great accuracy to volume, a first liquid, here called primary liquid, with the second liquid, here called secondary liquid, the mixing ratio being such that there is a very great difference between the individual volumes of the mixed liquids. As pointed out above, in many medicinal processes but also in connection with other processes, for

instance, colouring of a liquid or adding of e.g. enzymes or flavouring agents to a liquid, there is a need of adding a smaller amount of secondary liquid to an essentially larger amount of primary liquid. In a continuous mixing process, it is most important that the mixing ratio, in spite of the differences in volume between the mixed liquids, is constant and controllable all the time during the process, such that, for instance, the flavour or the enzyme content of the resulting mixed liquid will not vary.

The apparatus shown in Fig. 1 consists of a flow pipe 26 for primary liquid, the amount of passing primary liquid being controllable by means of a flow meter 22, which registers the amount of passing primary liquid and which by means of the regulator 20 controls the speed of the peristaltic pump 21. In the case shown, the secondary liquid is taken from a plastic bag 19 containing, in this case, sterilised secondary liquid 28. The secondary liquid 28 is passed via the conduit 27 to a peristaltic pump 21 controlled by the regulator 20 and being of known type, comprising a rotatable cylindrical body 29, which at its circumference supports rollers 30, which in the case shown are positioned diametrically opposite each other in the cylindrical body 29, and which with its rollers projects outside the periphery of the rotatable body 29. At least part 27' of the conduit 27 is made of a flexible material, e.g. rubber or plastic, and this part 27' of the conduit 27 is arranged in a duct 31 of the pump 21.

During rotation of the cylindrical body 29, the flexible conduit 27' is compressed by the rollers 30, the liquid contained in the conduit 27' between the rollers 30 being pressed forwards by the rollers 30 in the direction of rotation of the cylindrical body 29 and thus being pumped forwards. Since the dimension of the tube 27' is known and the speed of rotation of the cylindrical body 29 is controllable, the amount of pumped liquid in

the conduit 27 can be very accurately controlled and the flow can be kept very constant. To be able to stop the pump 21 and the mixing process if the flow in the conduit 27 is interrupted, a flow control device 23 is arranged at or in the vicinity of the terminal point of the conduit 27. The secondary liquid 28 supplied as described above is added to the primary liquid by means of a specially arranged inlet chamber 25 which is shown in detail in Fig. 2. The inlet chamber 25, which is connected to the conduit 26 for primary liquid, is provided with a connecting flange 32, which is located in the position where the conduit 26 in the case shown makes a bend and, in the bend of the conduit, has a liquid-flow-conducting labyrinth 31 for guiding the flow of primary liquid towards the inlet chamber 25. The inlet chamber 25 is provided with a connecting flange 33, which matches the conduit flange 32 and which is provided with seals 34 closely connected to each other. The inlet chamber 25 also has spaces 35, which can be kept sterile by means of a sterilising agent, e.g. vapour or a sterilising liquid, supplied through the conduit 10. The passing vapour or liquid sterilises the spaces 35 and all the objects that are present or may be present in the spaces 35. Moreover, the inlet chamber 25 has one or more spaces 14, which are adapted to receive injection needles or syringe-like cannulae comprising a hypodermic needle 12 and a connection 36 to the conduit 27.

As shown in Fig. 2, the inlet chamber 25 may be provided with several spaces 14 for hypodermic needle arrangements which, adjacent to said connection 36, are sealed against the inlet chamber 25 by means of a sealing ring 37 of O ring type.

The cannula 12 is thus displaceably movable in the chamber 14 by displacing the connection 36 with the sealing ring 37. That part of the inlet chamber 25 which connects to the primary liquid conduit 26 has a sealing wall 38 made of rubber or a rubber-like material, which can

easily be penetrated by the cannula 12 and which, after retraction of the cannula 12 into the space 14, in a self-sealing manner attaches itself around the hole made by the cannula 14 in the sealing wall 38. Thus, the cannula 12 can, when positioned in the space 14, be sterilised and be made to retain its sterility to be passed through the sealing wall 38 into the conduit 26 for supplying, in an accurately predetermined dose, secondary liquid 28 to the flowing primary liquid. The cannula 12 can also be retracted into the space 14 without interruption of the sterility. As shown, the connection 36 to the cannula 12, 13 is provided with a flange 39. After insertion of the cannula 12, 13 into the conduit 26, the cannula 12, 13 can be locked in the inserted position by a stop flange 40 being pushed over the flange 39, the position of the cannula 12 and the associated connection 36 being fixed. To achieve a good mixing of primary liquid and secondary liquid or secondary liquids, the conduit 26' for the mixed liquids is provided with a mixing chamber 24 having surfaces deflecting the flow of liquid to achieve, under turbulent flow, a homogeneous mixing of the joined liquids. Fig. 3 shows an example of the above-described bag 19 for secondary liquid, and as is obvious, the bag is provided with two connections 27, 3, the connection 3 constituting the filling conduit and the tube 27, as described above, constituting the discharge conduit for secondary liquid. Of course, the tank for secondary liquid 19 need not necessarily be a plastic bag but may be a more dimensionally stable vessel made of plastic or metal, and it is not necessary to the invention that the supplied secondary liquid or, for that matter, the primary liquid be a sterile liquid.

It should be added that in the cases where several secondary liquids are to be supplied, not only the inlet chamber must be provided with several chambers and cannulae for secondary liquid 28, but also that each secondary liquid 28 necessitates its own storage tank 19, its own

pump 21 and its own regulator 20, unless the secondary liquids are not of such a nature that even in the storage tank they can be mixed to a common "secondary liquid mixture". An inlet chamber with a number of cannula positions may be practical to use with a view to making it possible to stop the process without shifting from a secondary liquid tank 19 to another when the first tank is empty. Such a "flying shift" of the secondary liquid tank 19 is possible to perform if the inlet chamber 25 is provided with several cannula spaces in the manner as described above.

It has been found that the device according to the present invention results in a permanent, very exact mixing ratio also during long continuous operation even if the volume ratio when mixing the liquids is extremely nonuniform.

As mentioned, it is also possible to mix, under uninterruptedly aseptic conditions, sterile liquids, and it is also easy during the mixing operation, if desired, to adjust the mixing ratio with very great accuracy.

CLAIMS

1. A dosing device for mixing in a continuous process a flowing primary liquid with one or more added secondary liquids (28) of an essentially smaller quantity 0.05-1% for obtaining a flowing liquid mixture at a permanent uniform mixing ratio of the mixed liquids, c h a r a c t e r i s e d by a flow pipe (26), through which the primary liquid is caused to flow, a mixing chamber (24) arranged in said flow pipe or connected in series therewith, one or more pumps (21) for continuous supply of said secondary liquid (28) from a storage tank (19) for secondary liquid to one or more narrow nozzles (12), which are insertable into said flow pipe, said nozzles (12) consisting of one or more needle-like tubes, which are insertable into the flow pipe (26) through a penetratable flexible wall part which is sealingly arranged in a perforated wall part arranged in the flow pipe.

2. A dosing device as claimed in claim 1, c h a r a c t e r i s e d in that said nozzles (12) for supplying secondary liquid (28) in their inserted position are located in parallel with the flow path of the primary liquid and preferably centrally arranged therein.

3. A dosing device as claimed in claim 1, c h a r a c t e r i s e d in that said nozzles (12) for supplying secondary liquid (28) consist of injection-needle-like devices having a preferably obliquely cut-off pointed portion and having inlet openings provided with connecting means for connecting the injection-needle-like nozzles (12) to tubes or conduits (27) for supplying secondary liquid (28).

4. A dosing device as claimed in claim 1, c h a r a c t e r i s e d in that the storage tank or storage tanks (19) containing secondary liquid (28) consist of preferably sterilised bags or non-yielding containers

made of a flexible plastic material or metal, and that the contents of the tanks (19) preferably consist of a sterile liquid.

5. A dosing device as claimed in claim 4, characterised in that said storage tanks (19) each have two connection ducts (27, 3) in the form of tubes or conduits, which communicate with the interior of the tank and of which one is a supply duct (3) and the other is a liquid-discharging duct (27), each of the connection ducts being adapted to permit separate closing and opening.

6. A dosing device as claimed in claim 1, characterised in that said pump or pumps (21) for supplying secondary liquid (28) preferably consist of peristaltic pumps with infinitely variable adjustment of the pump capacity.

7. A dosing device as claimed in claims 1 and 6, characterised by a flow meter (22) for measuring the flow of the flowing primary liquid in said flow pipe (26), and a regulator (20) which, controlled by said flow meter (22), regulates the speed of rotation and, thus, the flow from said peristaltic pump or pumps (21) in such manner that one of or said secondary liquids (28) are admixed to the flowing primary liquid in a controllable manner and in a controllable quantity.

8. A dosing device as claimed in claim 1, characterised in that one or more sterile filters are arranged in the connection duct or connection ducts (27) between said tank for secondary liquid (19) and said nozzle (12) for supplying secondary liquid to said primary liquid.

9. A dosing device as claimed in claim 1, characterised in that said mixing chamber (24) has a plurality of deflection parts located in the flow pipe (26) and adapted to deflect the direction of flow for partial amounts of said primary liquid and said supplied secondary liquids for the purpose of producing a turbu-

lent flow and obtaining a homogeneous mixing of the liquids supplied.

10. A dosing device as claimed in claim 1, c h a r a c t e r i s e d in that said flexible and penetratable wall part in the flow pipe has a space through which a sterilising liquid can flow, said sterilising liquid, at least during insertion of the needle-like nozzles, being made to surround or flow around parts of said needle-like nozzles which are insertable through said wall part.

11. A dosing device as claimed in claim 10, c h a r a c t e r i s e d in that the insertion part (25) of said needle-like nozzle (12) has a space (14), which is filled with sterilising liquid or can be passed thereby and which has an outlet wall (38) made of a penetratable, flexible material, preferably rubber or a rubber-like material, the needle-like nozzle (12), before penetration of the outlet wall (38) of said space (14), being surrounded by or flushed with sterile liquid, and that the nozzle (12), through further movement in the longitudinal direction of the nozzle, is caused to penetrate said outlet wall (38) for penetrating, with its sterilising needle part, into said flow pipe (26).

12. A dosing device as claimed in claim 1, c h a r a c t e r i s e d by a connection means (25) for supplying secondary liquid (28), comprising a holder which is connectible to said flow pipe (26) and intended for said needle-like nozzles (12, 13), said holder having at least two guide sleeves (22) adapted to support and longitudinally guide the position of said nozzles (12, 13), said needle-like nozzles (12, 13) each being slidably attached in said sleeves (2) which are sealingly arranged against the space (35), that the interior of said sleeves (2) or spaces in their longitudinal extension each open at a flexible and penetratable wall (38) preferably made of a rubber-like material, said wall (38) separating said spaces (35) from the interior of said

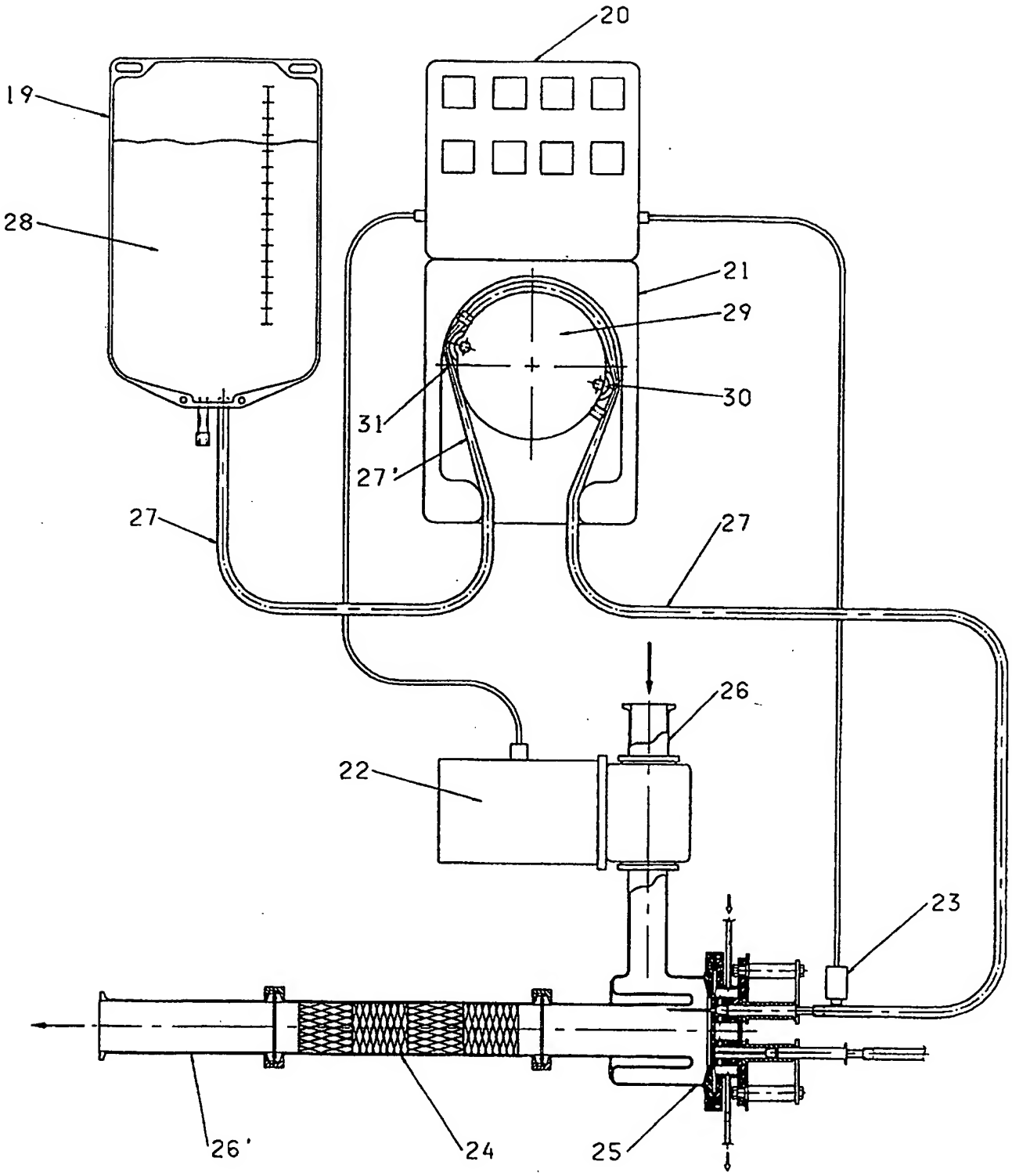
flow pipe (26), said needle-like nozzles (12, 13) being individually operable in their sleeves (2) in such manner that, independently of each other, they can be moved in the longitudinal direction of the nozzles (12, 13) and be caused to penetrate said flexible partition wall (38) for the purpose of locating the point (12) of the needle-like nozzle in the flow pipe (26) for the purpose of supplying said secondary liquid or liquids (28) to said primary liquid.

13. A method of mixing two or more liquids, one or more secondary liquids (28) from a storage tank (19) being pumped into a flowing primary liquid and mixed therewith to obtain a homogeneous liquid mixture, c h a r a c t e r i s e d in that the secondary liquid or secondary liquids (28) are pumped from the storage tank (19) by means of a flow pump (21), and that the secondary liquids (28) are supplied to said primary liquid by a needle-like nozzle (12, 13) being inserted through a flexible, rubber-like wall part (38) of the flow pipe (26), through which the primary liquid is passed, preferably at a constant flow rate.

14. A method as claimed in claim 13, c h a r a c t e r i s e d in that said primary liquid consists of foodstuffs or medicinal products, and that the secondary liquid or secondary liquids (28) consist of, for instance, enzyme, flavouring agents, colourants, vitamins, bacteria or medicinal products.

15. A method as claimed in claim 14, c h a r a c t e r i s e d in that said primary liquid can be pasteurised or sterilised.

FIG.I



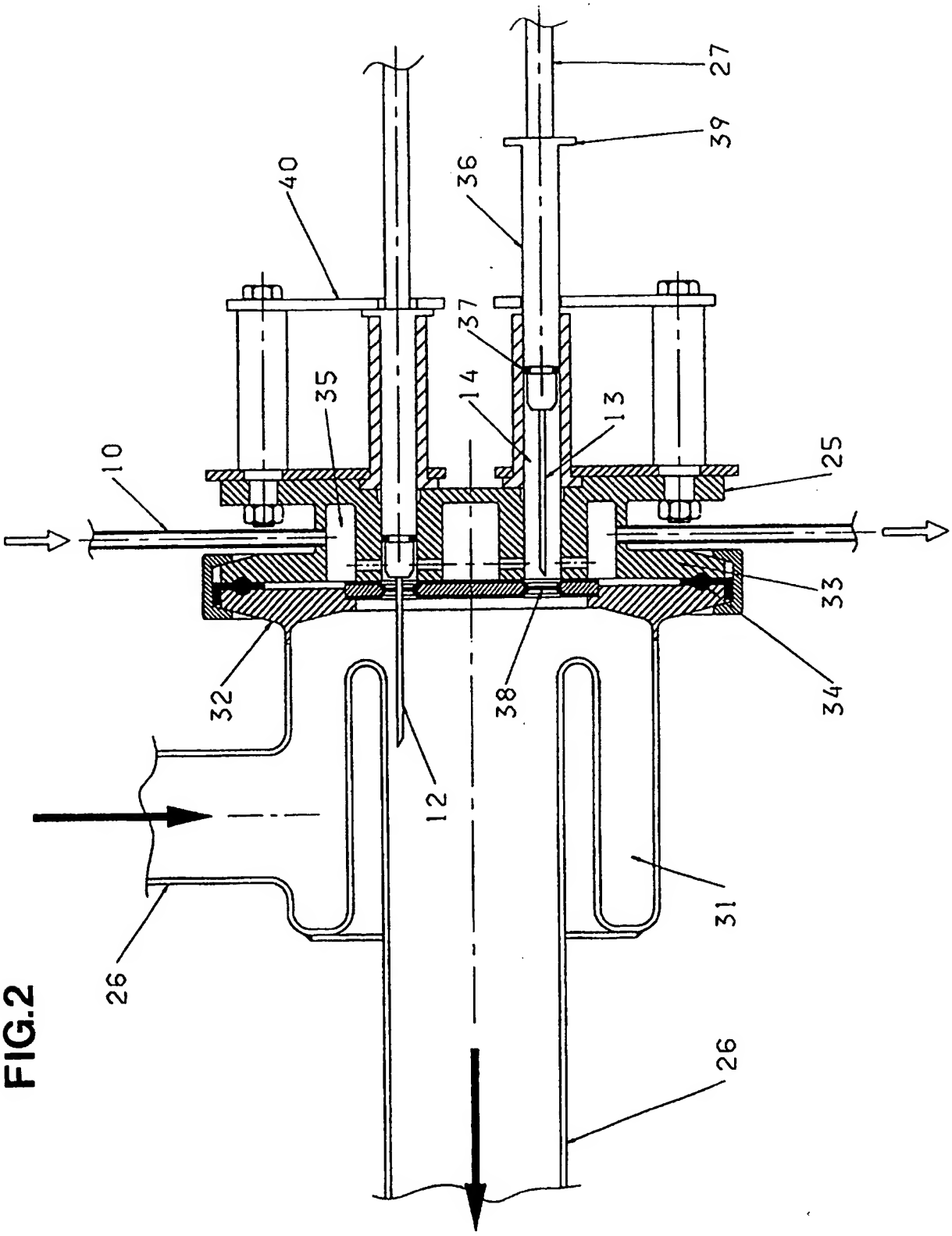
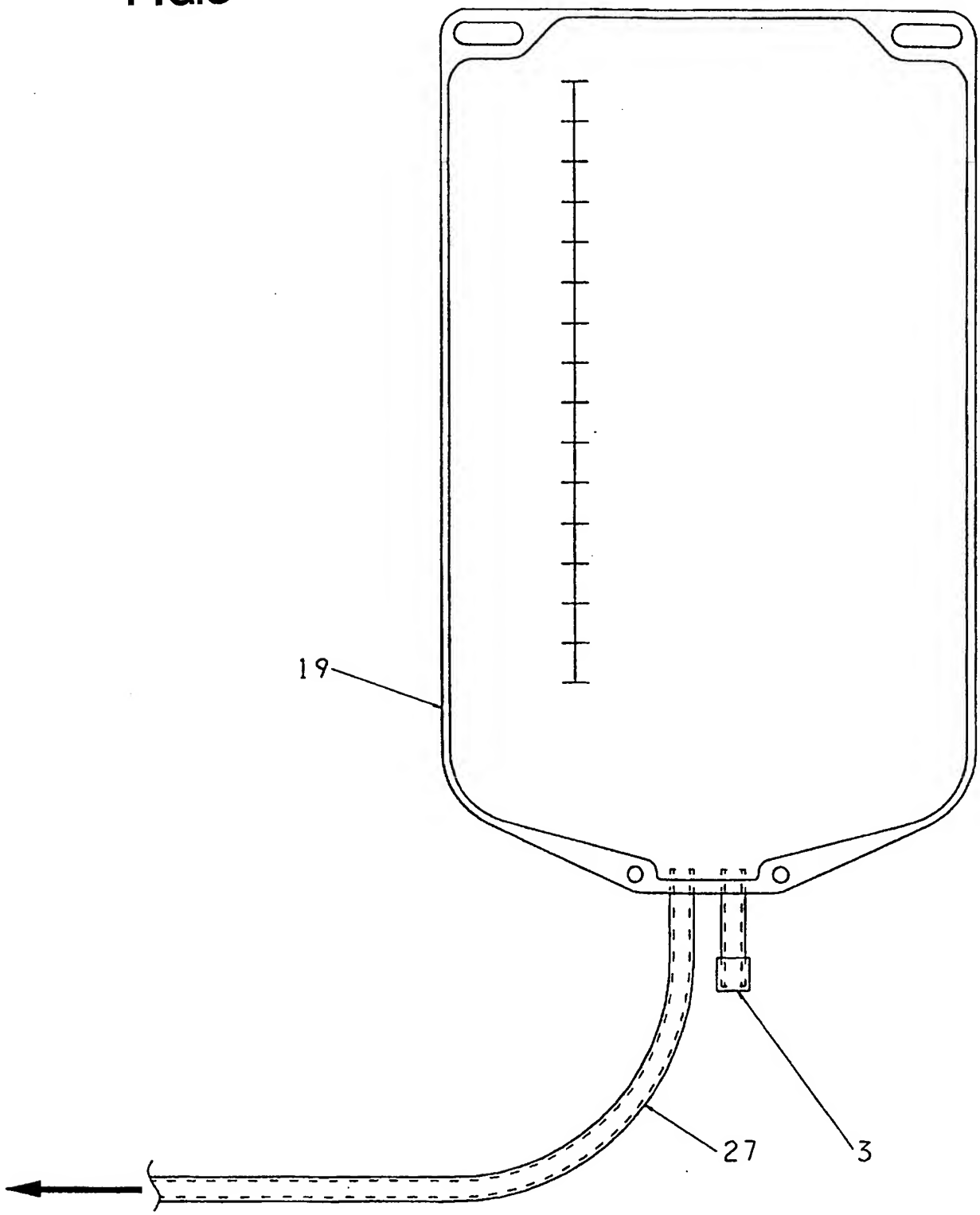


FIG.2

FIG.3



INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9116138 A1 (S.C. JOHNSON & SON, INC.), 31 October 1991 (31.10.91) --	1,13

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9116138 A1	31/10/91	AT 142912 T	15/10/96
		AU 7772691 A	11/11/91
		CA 2080817 A	24/10/91
		DE 69122243 D,T	06/02/97
		EP 0526593 A,B	10/02/93
		SE 0526593 T3	
		ES 2091947 T	16/11/96
		NZ 237843 A	26/08/94
		NZ 248774 A	26/08/94
		US 5544810 A	13/08/96